

# Change and the Heartland

Big issues, bite-sized lessons

How Climate Change Will Affect the Midwest



## What Will Happen to Fish and Aquatic Wildlife?



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**A**quatic communities are an important resource for the Midwest. These ecosystems provide drinking water, food, and recreation opportunities for millions of people, and they are essential for the health and functioning of the terrestrial environments that surround them. Today's aquatic communities are the result of a host of interactions between species and their environment, and the structure of these communities is dictated by a balance of processes such as predation, competition, and reproduction that have taken centuries to become established.

### Climate Change Will Alter the Character of the Midwest's Aquatic Ecosystems

Currently, climate change is threatening to upset the balance in aquatic communities, with potentially serious consequences. As air temperatures increase, so do water temperatures, and increases in water temperature may dramatically change aquatic ecosystems. Scientists in the Midwest with access to long-term data have documented that lakes in this region have begun freezing later in the year and starting to melt earlier in the year compared with 150 years ago, demonstrating the impact of climate change on the area's water bodies. It is almost certain that climate will continue to warm in the coming decades; the exact impacts on aquatic ecosystems are not known, but a number of shifts are likely.

### Warmer Water May Have Negative Effect on the Fish and Aquatic Wildlife in the Midwest

Most organisms on the planet have an optimal temperature at which their bodies function best. Fish and other aquatic organisms are no exception, and, because they are "cold-blooded," their internal temperature is dictated by the temperature of

#### Key Term

### Thermal Habitat

Thermal habitat is the range of water temperatures in which fish can survive and reproduce most successfully. Fish are generally classified as cold-, cool-, or warm-water fish. Cold-water fish prefer temperatures under 68 degrees Fahrenheit. Cool-water fish thrive between 68 and 76 degrees, and warm-water fish at 76 degrees and higher.

As climate change increases the average temperatures in our lakes in rivers, cold-water fish will have to adjust along with the temperatures, either by living at greater depths or shifting northward.

#### Thermal Habitats of Common Fish

Cold-water: rainbow trout

Cool-water: smallmouth bass, walleye

Warm-water: largemouth bass, striped bass, Roanoke bass, white bass, black crappie, yellow perch, various catfish species and bullheads

the water around them. Fish become less active in the winter, and in summer their biological processes run faster, requiring more food and oxygen. Fish have optimal temperatures, which are one factor that defines the geographical ranges for aquatic organisms; at temperatures higher or lower than optimal, performance can be compromised, thereby limiting organisms' distributions.

Inversely related to temperature is the amount of oxygen dissolved in water; warmer water contains less

# Climate Change Puts Aquatic Life in Hot Water

oxygen than cooler water, resulting in increased oxygen demand for cold-blooded organisms and less oxygen provided in the environment. Warming of the environment can thus have a host of negative consequences for aquatic organisms that can result in dramatic changes to ecosystems.

### Southern Limits of Some Midwestern Fish May Shift Northward

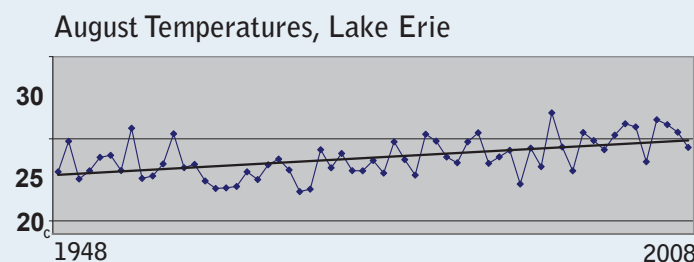
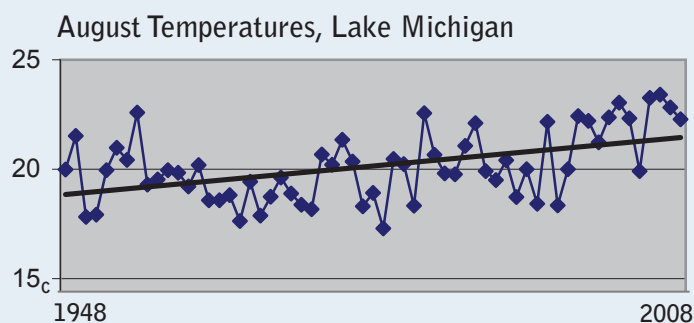
“Habitat” refers to the set of living and nonliving factors that are required by organisms to survive. Temperature, which is one component of habitat, is a resource that organisms seek, similar to food and shelter. As climate-induced increases in temperature occur and oxygen availability decreases, the habitat characteristics for aquatic organisms can become suboptimal, potentially threatening their survival.

The first inclination of aquatic organisms when confronted with habitat challenges is simply to shift locations and seek conditions closer to those they prefer. However, depending on the species, its ability to move, its current distribution, and the conditions in its current water body, such optimal habitat might not exist, and organisms might be forced to either leave altogether or risk becoming vulnerable to predation. For fish in the Midwest, one of the main predictions from increased global temperatures is a reduction in thermal habitat, coupled with a northward shift in ranges as individuals and species migrate to cooler water closer to their optimums. For commercial fisheries in the ocean, such consequences could be more severe and could result in the migration of a food source out of a local area, potentially having negative consequences on communities that might depend on these fish for protein.

### Climate Change’s Effect on Complex Aquatic Ecosystems Is Difficult to Predict

While the northward migration of species is likely, the indirect and ecosystem-level consequences of shifts induced by climate change are not certain. An ecosystem comprises an interacting web of species that are coupled by processes such as predation, competition, and reproduction that have all taken centuries to reach equilibrium. If a novel species is introduced to this balance, or if a particular species should become less abundant due to thermal limitations, the consequences for the ecosystem are difficult to predict. Increased temperatures won’t just impact mobile organisms such as fish; primary producers such as plants,

## Great Lakes Temps Are Trending Upward



As temperatures in aquatic habitats shift, fish and other creatures will have to shift with them.

phytoplankton, and algae will also be affected by warmer temperatures, with potential changes in productivity. Thus, while it is possible to predict the impact of climate change on individual species, linking changes to ecosystem-level alterations remains a challenge.

### Comprehensive Monitoring Needed to Understand and Mitigate Climate’s Effect on Aquatic Resources

It is important that we continue comprehensive monitoring and observation programs to document not only the abundance of and distribution of aquatic organisms but also changes to temperature, oxygen, and other characteristics of aquatic ecosystems. Improved monitoring will help scientists identify any changes to aquatic communities, thereby providing clearly defined paths for future conservation activities to protect them.

#### About the Researcher

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